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(54) Title: IMPROVEMENTS RELATING TO SUBSTITUTED ISETHIONATE SURFACTANTS AND PERSONAL CARE COMPOSITIONS COMPRISING SAID SURFACTANTS (57) Abstract The invention provides for the use of the substituted isethionate ester: RCOO-CHR ₁ -CHR ₂ -SO ₃ M wherein M is a monovalent cation or equivalent thereof, R is alkyl, R ₁ is hydrogen or alkyl and R ₂ is hydrogen or alkyl, provided that R ₁ and R ₂ are not both hydrogen, in medicine and for the manufacture of a medicament for use in the treatment or prophylaxis of erythema. The invention also extends to a method for the cosmetic treatment of the human body which includes the step of treating the surface of the skin with a composition including the substituted isethionate ester and further extends to compositions comprising the substituted isethionate ester and at least 20 % water.		

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- 1 -

IMPROVEMENTS RELATING TO SUBSTITUTED ISETHIONATE
SURFACTANTS AND PERSONAL CARE COMPOSITIONS
COMPRISING SAID SURFACTANTS

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Field of the Invention

10 The present invention relates to compounds of the type
formed when hydroxy alkane sulphonic acids are esterified
with carboxylic acids, to compositions comprising said
surfactants and to uses of said surfactants.

15 Background of the Invention

Traditionally, soap has been utilised as a skin cleanser.
Soap is, however, a very harsh chemical. Irritated and
cracked skin result from use of soap, especially in colder
20 climates and seasons.

There has been much commercial activity in attempting to
replace soaps with milder surfactants. The introduction
of mild synthetic detergent toilet bars, especially those
25 based on sodium cocoyl and tallowy isethionates, has been
particularly successful. Patents relating to this
technology are fully discussed in U.S. Patent No. 4954282,
which is incorporated by reference herein.

30 A characteristic feature of isethionates is that they
exhibit excellent skin mildness in clinical studies.
Other surfactants, particularly fatty acid soaps, are not
so mild and may cause damage to sensitive skin. This
damage often initially takes the form of mild erythema
35 which can develop through a more severe stage in which

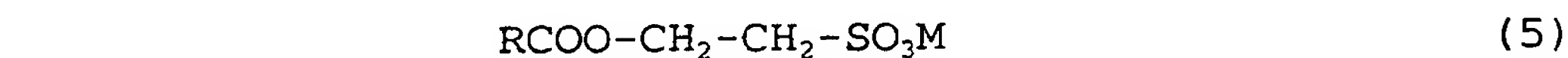
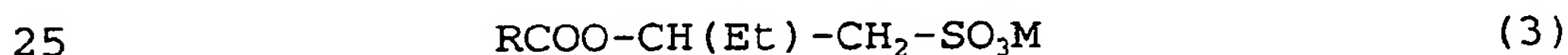
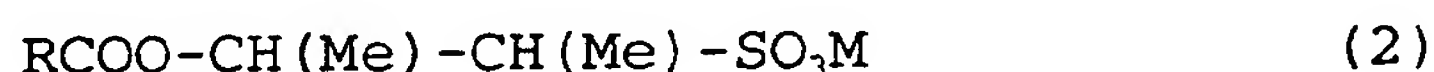
- 2 -

edema occurs to a particularly severe stage at which vesiculation of the skin occurs.

5 With this problem in mind, past workers have concerned themselves with the provision of isethionate compositions which are low in contaminants. For example US 2999871 and US 2923724 relate to molecules defined as having the general formula (1) given below:



Wherein M is a monovalent cation, R is alkyl and R1 is either hydrogen (i.e. the molecule is an ester of isethionate), methyl or ethyl. These molecules are formed by condensation of the hydroxy alkane sulphonic acid with a suitable carboxylic acid. Suitable sulphonic acids include 2-hydroxy-3-butane sulphonic acid (2), 2-hydroxy-1-butane sulphonic acid (3), 2-hydroxy propane sulphonic acid (4) and isethionic acid (5). The proposed condensations are believed to give the products listed below with the appropriate number.



Due to the use of this synthetic route, low levels of mineral acid salts of alkali metals, alkaline earths and tertiary amines are expected to be present in the reaction product. Consequently, the molecules are proposed for applications where more than traces of these contaminants are undesirable, such as built soap bars, skin creams,

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- 3 -

lotions, salves and food products. Where the contaminants, particularly calcium ions, are present they interfere with the properties of the surfactants.

5 A known further problem with isethionates and their derivatives is that of hydrolytic instability. Where hydrolytic instability is present, compounds cannot be formulated into stable products wherein the compounds are largely present in solution, such as shampoos and light
10 duty liquid cleaners as the ester will hydrolyse in solution to the carboxylic acid and the isethionate or derivative neither of which have good wetting or foaming properties.

15 US 280644 identifies a specific class of sulphonated esters which have both an alpha-sulpho group in the fatty acid residue and a methyl group at the alcoholic carbon of the isethionate derivative. These esters are described as being more stable than other ester type surface active
20 agents and as being insensitive to dissolved salts such as are found in hard water or sea water.

A technical problem faced by the formulators of personal washing and personal care products is therefore that of
25 finding mild surfactants, which are hydrolytically stable and which are insensitive to the salts commonly found in water or present in compositions. As mentioned above, these problems are particularly apparent in compositions of a liquid or gel form where relatively high levels of
30 water are present in the products.

Brief Description of the Invention

35 We have now identified that selected hydroxy alkane sulphonic acid esters exhibit excellent hydrolytic

- 4 -

stability and acceptable clinical mildness, while being relatively insensitive to the presence of calcium.

5 In particular, isethionate esters having an alkyl group at the alcoholic carbon, i.e. ester derivatives of secondary hydroxy alkane sulphonic acid are believed to exhibit acceptable clinical mildness, and a significant improvement in calcium tolerance and hydrolytic stability as compared with the derivatives of a primary hydroxy
10 alkane sulphonic acid.

Detailed Description of the Invention

15 Accordingly the present invention provides the substituted isethionate ester:



20 wherein M is a monovalent cation or equivalent thereof, R is alkyl, R1 is hydrogen or alkyl and R2 is hydrogen or alkyl, provided that R1 and R2 are not both hydrogen, for use in medicine.

25 A further aspect of the present invention provides the use of the substituted isethionate ester:



30 wherein M is a monovalent cation or equivalent thereof, R is alkyl, R1 is hydrogen or alkyl and R2 is hydrogen or alkyl, provided that R1 and R2 are not both hydrogen, for the manufacture of a medicament for use in the treatment or prophylaxis of erythema.

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- 5 -

A yet further aspect of the present invention subsists in a method for the cosmetic treatment of the human body which includes the step of treating the surface of the skin with a composition including the substituted isethionate ester:



wherein M is a monovalent cation or equivalent thereof, R is alkyl, R₁ is hydrogen or alkyl and R₂ is hydrogen or alkyl, provided that R₁ and R₂ are not both hydrogen.

Without wishing to be restricted by any theory of operation it is believed that one of the reasons for the mildness of the present compositions is due to a decreased interaction between the anionic surfactant and skin proteins, due to a dispersion of the charge on the surfactant as a result of the bulky head group of the surfactant.

Moreover, it is believed that the presence of substituted group in the isethionate residue provides a steric hindrance to attack from a hydroxyl ion or water thereby rendering the molecule less susceptible to hydrolysis under aqueous alkaline or acidic conditions. As will be discussed with reference to the examples given hereinafter, hydrolysis testing has shown that the molecules of the present invention possess improved hydrolytic stability as compared with sodium cocoyl isethionate (SCI).

Accordingly the present invention further provides a personal washing composition comprising (a) the substituted isethionate ester:



- 6 -

wherein M is a monovalent cation or equivalent thereof, R is alkyl, R₁ is hydrogen or alkyl and R₂ is hydrogen or alkyl, provided that R₁ and R₂ are not both hydrogen and (b) at least 20% water.

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The substituted isethionate ester salts that may be employed herein are acyl esters of substituted isethionates and preferably the cocoyl ester. These preferred esters may be prepared from the usual cocoyl fatty acids. Consequently the product formed will generally be a mixture of compounds having different R groups.

Preferably, the R groups present will be a mixture of primary, unbranched alkyl chain having small percentage of fatty acids chains below C₇ with over 95% of the carbon chain distribution being between C₇ and C₁₇ and more than half being C₁₁ or less. The acyl chain length of the esters will have at least about 90% C₅-C₁₇ and more than about 30% C₁₄ or lower.

As indicated in further detail below the substituted isethionates are conveniently prepared by reaction of fatty acids or fatty acid chlorides with selected substituted isethionates. The substituted isethionates are themselves prepared by reaction of a suitable epoxide with a suitable sulphating agent such as sodium bisulphite.

The preferred R₁ and R₂ groups are primary, unbranched C₁-C₄ alkyl groups. More preferably, the total number of carbon atoms included in R₁ and R₂ is from 1 to 6, most preferably 2-3.

Since the epoxide may comprise a single compound or a mixture of compounds it is envisaged the products

- 7 -

according to the invention may comprise mixtures of compounds different groups R_1 and R_2 .

5 Preferably the total number of carbon atoms in groups R, R_1 and R_2 is on average from 8 to 14.

10 It is particularly preferable that the R_1 group is predominantly methyl, ethyl, propyl or butyl and the R_2 group is hydrogen. In the most preferred embodiments of the invention the R_2 group is ethyl.

Preferably the compound (6) is presented in the form of a personal washing composition comprising:

- 15 a) the substituted isethionate ester (6), and,
b) at least one further surfactant other than soap.

20 Accordingly, the present invention provides a composition comprising:

- a) the substituted isethionate ester (6), and,
b) at least one additional surfactant other than soap.

25 The at least one additional surfactant may comprise an anionic, a nonionic, cationic, zwitterionic or amphoteric synthetic detergent material, or mixtures of any of these.

30 Examples of the many supplementary surfactants which may be used are set forth in surface active agents and detergents by Schwartz et al., Interscience Publishers, hereby incorporated by reference into the present specification.

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- 8 -

Examples of the anionic synthetic detergents are salts (including sodium, potassium, ammonium and substituted ammonium salts) such as mono-, di- and triethanolamine salts of 9 to 20 carbon alkylbenzenesulphonates, 8 to 22 carbon primary or secondary alkanesulphonates, 8 to 24 carbon olefinsulphonates, sulphonated polycarboxylic acids prepared by sulphonation of the pyrolysed product of alkaline earth metal citrates, e.g., as described in British Patent specification, 1,082,179, 8 to 22 carbon alkylsulphates, 8 to 24 carbon alkylpolyglycol-ether-sulphates, -carboxylates and -phosphates (containing up to 10 moles of ethylene oxide); further examples are described in "Surface Active Agents and Detergents" (vol. I and II) by Schwartz, Ferry and Bergh.

One particularly preferred non-soap anionic is a C_8-C_{22} alkyl unsubstituted isethionate. These ester may be prepared by the reaction between alkali metal isethionate and mixed aliphatic fatty acids having from 8 to 22 carbons.

In general, the compositions include about 7 to 35% of the branched chain isethionates together with a supplementary surfactant selected from the group consisting of anionic, nonionic, cationic, and ampholytic. The range of isethionate to supplementary surfactant is about 1:2 to 10:1.

The non-soap actives preferably comprise, in total, from 0 to 50% of the composition.

Alkyl ether sulphate surfactants are particularly preferred components of compositions according to the present invention. A sulphate ester surfactant may comprise .01 to 45% by weight of the composition (as the

- 9 -

monoester), preferably 25% to 40%, and .01% to 10% of the composition (as the diester), preferably .01% to 5%.

5 Examples of nonionic synthetic detergents which may be used with the invention are the condensation products of alkylene oxides, such as ethylene oxide and propylene oxide with 8 to 18 carbon alkylphenols, 8 to 18 carbon fatty acid amides; further examples of nonionics include tertiary amine oxides with 8 to 18 carbon alkyl chain and
10 two 1 to 3 carbon alkyl chains.

The average number of moles of ethylene oxide and/or propylene oxide present in the above nonionics varies from 1-30; mixtures of various nonionics, including mixtures of
15 nonionics with a lower and a higher degree of alkoxylation, may also be used.

Examples of cationic detergents which may be used are the quaternary ammonium compounds such as
20 alkyldimethylammonium halogenides.

Zwitterionic surfactants such as alkyl amine oxides, alkyl betaines, alkyl amido betaines mixtures and the like are also included in ratios of isethionate to zwitterionic of
25 about 1:1 to 2:1. The amphoteric surfactants disclosed in U.S. 4,992,211 may also be used.

Examples of further amphoteric or zwitterionic detergents which may be used with the invention are N-alkylamine
30 acids, sulphobetaines, condensation products of fatty acids with protein hydrolysates.

It is particularly desirable for the substituted isethionates of the present invention to be combined with
35 selected betaines to provide further mildness to the skin

- 10 -

together with good product properties such as good lather volume.

5 Betaines and the sub-class amidobetaines are known to be very mild to both skin and eyes. The cocamidobetaines, in particular, have good lather properties.

10 Mixtures of the various types of active detergents may also be used, and preference is given to mixtures of an anionic and a nonionic detergent active.

15 Further examples of surfactants and surfactant combinations are given below as regards particular embodiments of the invention.

Preferred Compositions

20 The compositions according the present invention can take several product forms, including toilet bars, facial or body cleansing composition, a hair or body shampoo, conditioner composition, toothpaste, shaving creams and lotions, shower gels deodorant/antiperspirant compositions and cosmetic compositions.

25 Liquid, gel and paste form products are particularly preferred. As mentioned above, such compositions would be prone to hydrolytic stability if formulated with unsubstituted isethionate. However, as discussed with
30 reference to the examples given hereinafter, the compositions of the present invention are less prone to hydrolytic instability. Consequently, compositions of the present invention advantageously comprise at least 20%wt, preferably at least 35%wt water.

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- 11 -

All of these compositions are intended to come into contact with human skin during normal use. Further details as regards these specific compositions are given below.

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Toilet Bars

10 First preferred embodiments of the present invention comprise toilet bars.

Typical toilet bar compositions are those comprising fatty acid soaps used in combination with a detergent other than fatty acid soap.

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It should be noted that the compositions embodying the present invention may comprise some fatty acid soap or may be based merely on actives other than fatty acid soap. As previously noted, soap may be somewhat harsh and when present in the compositions of this invention should be at a level no higher than about 35%, preferably less than 20%wt, most preferably less than 10%wt and advantageously totally absent.

25 Mildness improving salts, such as alkali metal salt or isethionate, are also typically added. In addition other ingredients, such as germicides, perfumes, colourants, pigments, suds-boosting salts and anti-mushing agents may also be added.

30

Fatty acid soaps are typically alkali metal or alkanol ammonium salts of aliphatic alkane or alkene monocarboxylic acids. Sodium, potassium, mono-, di- and tri-ethanol ammonium cations, or combinations thereof, are suitable for purposes of the invention. The soaps are well known alkali metal salts of natural or synthetic

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- 12 -

aliphatic (alkanoic or alkenoic) acids having about 8 to 22 carbons, preferably 12 to about 18 carbons. They may be described as alkali metal carboxylates of acrylic hydrocarbons having about 12 to 22 carbons.

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Examples of soap which may be used may be found in U.S. Patent No. 4,695,395 to Caswell et al. and U.S. Patent No. 4,260,507 (Barrett), both of which are incorporated herein by reference.

10

The compositions also generally comprise a non-soap detergent which is generally chosen from anionic, nonionic, cationic, zwitterionic or amphoteric synthetic detergent materials or mixtures thereof. These surfactants are all well known in the art and are described, for example, in U.S. Patent Nos. 4,695,395 and 4,260,507 as well as being discussed above.

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A certain amount of free fatty acids of 8 to 22 carbons are also desirably incorporated into soap compositions to act as superfatting agents or as skin feel and creaminess enhancers. If present, the free fatty acids comprise between 1 and 40% of the compositions.

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A preferred salt which may be added to compositions is a simple unsubstituted sodium isethionate. This may be present as 0.1 to 50% of the composition, preferably .5% to 25%, more preferably 2% to about 15% by weight. Other mildness co-actives which may be used include betaine compounds or ether sulphates. These also may be present at 0.1 to 50% of the composition, preferably 0.5% to 25%.

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Other optional ingredients which may be present in toilet bar compositions are moisturisers such as glycerin, propylene glycol, sorbitol, polyethylene glycol, ethoxylated or methoxylated ether of methyl glucose etc;

- 13 -

water-soluble polymers such as collagens, modified
celluloses (such as Polymer JR^(R)), guar gums and
polyacrylates; sequestering agents such as citrate, and
emollients such as silicones or mineral oil. another
5 useful set of ingredients are various cosurfactants and
non-soap detergents.

Cleansing bars containing 0 to 40% of unbranched alkyl
isethionate together with 10 to 50% of the branched
10 isethionate are also contemplated.

Facial and Body Cleansing Compositions

15 A second embodiment of the invention comprises a facial or
body cleansing composition. Examples of such cleaning
compositions are described, for example, in U.S. Patent
No. 4,812,253 to Small et al. and U.S. Patent No.
4,526,710 to Fujisawa, both of which are hereby
20 incorporated by reference.

Preferably compositions will comprises at least one
non-soap surfactant other than the substituted
isethionate. Preferably, this additional surfactant will
25 be a mild synthetic surfactant.

Cleaning compositions will also generally include a
moisturiser or emollient and polymeric skin feel and
mildness aids. The compositions may further optionally
30 include thickener (e.g., magnesium aluminum silicate,
carbopol), conditioners, water soluble polymers (e.g.,
carboxymethyl cellulose), dyes, hydrotropes brighteners,
perfumes and germicides.

35 Typically, cleansing compositions will comprise optional
fatty acid soap at relatively low levels. The fatty acid

- 14 -

soaps used are such as those described above in uses in detergent bar formulations. These soaps are typically alkali metal or alkanol ammonium salts of aliphatic or alkene monocarboxylic salts. Sodium, potassium, mono-,
5 di- and triethanol ammonium cations, or combinations thereof are suitable. Preferred soaps are 8 to 24 carbon half acid salts.

Surfactants can be chosen from anionic, nonionic,
10 cationic, zwitterionic or amphoteric materials or mixtures thereof such as are described in U.S. Patent No. 4,695,395 mentioned above, or in U.S. Patent No. 4,854,333 to Inman et al, hereby incorporated by reference.

15 Moisturisers are included to provide further skin conditioning benefits and improve mildness. This term is often used as synonymous with emollient and is then used to describe a material which imparts a smooth and soft feeling to skin surface.

20 There are believed to be two ways of reducing water loss from the stratum corneum. One is to deposit on the surface of the skin an occlusive layer which reduces the rate of evaporation. The second method is to add
25 nonocclusive hygroscopic substances to the stratum corneum which will retain water, and make this water available to the stratum corneum to alter its physical properties and produce a cosmetically desirable effect. Nonocclusive moisturisers also function by improving the
30 lubricity of the skin.

Both occlusive and nonocclusive moisturisers can work in the present invention. Some examples of moisturisers are long chain fatty acids, liquid water-soluble polyols,
35 glycerin, propylene glycol, sorbitol, polyethylene glycol, ethoxylated/propoxylated ethers of methyl glucose (eg.,

- 15 -

methyl gluceth-20) and ethoxylated/-propoxylated ethers of lanolin alcohol (e.g., Solulan-75).

5 Preferred moisturisers are coco and tallow fatty acids. Some other preferred moisturisers are the nonocclusive liquid water soluble polyols and the essential amino acid compounds found naturally in the skin.

10 Other preferred nonocclusive moisturisers are compounds found to be naturally occurring in the stratum corneum of the skin, such as sodium pyrrolidone carboxylic acid, lactic acid, urea, L-proline, guanidine and pyrrolidone.

15 Examples of other nonocclusive moisturisers include hexadecyl, myristyl, isodecyl or isopropyl esters of adipic, lactic, oleic, stearic, isostearic, myristic or linoleic acids, as well as many of their corresponding alcohol esters (sodium isostearoyl-2 lactylate, sodium capryl lactylate), hydrolysed protein and other
20 collagen-derived proteins, aloe vera gel and acetamide MEA.

25 Some occlusive moisturisers include petrolatum, mineral oil, beeswax, silicones, lanolin and oil-soluble lanolin derivatives, saturated and unsaturated fatty alcohols such as behenyl alcohol, squalene and squalene, and various animal and vegetable oils such as almond oil, peanut oil, wheat germ oil, linseed oil, jojoba oil, oil of apricot pits, walnuts, palm nuts, pistachio nuts, sesame seeds,
30 rapeseed, cade oil, corn oil, peach pit oil, poppyseed oil, pine oil, castor oil, soybean oil, avocado oil, safflower oil, coconut oil, hazelnut oil, olive oil, grape seed oil and sunflower seed oil.

35 Other examples of both types of moisturisers are disclosed in "Emollients -- a Critical Evaluation," by J. Mausner,

- 16 -

Cosmetics & Toiletries, May 1981, incorporated herein by reference.

5 Polymeric skin feel and mildness aids useful in the present invention are the cationic, anionic, amphoteric, and the nonionic polymers used in the cosmetic field. Reduced skin irritation benefits as measured by patch testing of cationic and nonionic types of polymers are set out in "Polymer JR for Skin Care" Bulletin, by Union Carbide, 1977. The cationics are preferred over the others because they provide better skin feel benefits.

15 The amount of polymeric skin feel and mildness aids found useful in the composition of the present invention is from about 0.01% to about 5%, preferably from about 0.3% to about 4%. In bar compositions with less than 5.5% soap, the polymer is used at a level of 2% to 5%, preferably 3% or more.

20 Other types of high molecular weight polymeric skin feel and skin mildness aids, such as nonionic guar gums, Merquats 100 and 550, made by Merck & Co, Inc.; Jaguar C-14-S made by Stein Hall; Mirapol A15 made by Miranol Chemical Company, Inc.; and Galactasol 811, made by
25 Henkel, Inc.; plus others, are usable. The polymer also provides enhanced creamy lather benefits.

30 The nonionic polymers found to be useful include the nonionic polysaccharides, e.g., nonionic hydroxypropyl guar gums, offered by Celanese Corp. a preferred nonionic hydroxypropyl guar gum material is Jaguar^R HP-60 having molar substitution of about 0.6. another class of useful nonionics is the cellulosic nonionic polymers, e.g., HEC and CMC.

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- 17 -

The cationic polymers employed in this invention also provide a desirable silky, soft, smooth in-use feeling. The preferred level for this invention is 0.1-5% of the composition. There is reason to believe that the positively charged cationic polymers can bind with negatively charged sites on the skin to provide a soft skin feel after use. Not to be bound by any theory, it is believed that the greater the charge density of the cationic polymer, the more effective it is for skin feel benefits.

Other suitable cationic polymers are copolymers of dimethyl-amino-ethyl-methacrylate and acrylamide and copolymers of dimethyl-diallyl ammonium chloride and acrylamide in which the ratio of the cationic to neutral monomer units has been selected to give a copolymer having a cationic charge. Yet other suitable types of cationic polymers are the cationic starches, e.g., Sta-Lok^R300 and 400 made by Staley, Inc.

A more complete list of cationic polymers useful in the present invention is described in U.S. Patent No. 4,438,095, to Grollier/allec, issued Mar. 20, 1984, incorporated herein by reference. Some of the more preferred cationics are listed in Col. 3, Section 2; Col. 5, section 8; Col. 8, section 10; and Col. 9, lines 10-15 of the Grollier/allec patent, incorporated herein by reference.

A particular advantage of the compositions of the present invention when embodied in the above-mentioned form is the hydrolytic stability of the substituted isethionate surfactant in water. Similar advantages arise in the compositions set forth below.

- 18 -

Hair or Body Shampoos

In a third embodiment of the invention provides a hair or body shampoo. Examples of such compositions are described in U.S. Patent No. 4,854,333, to Inman and U.S. Patent No. 4,526,710 to Fujisawa, both of which are hereby incorporated by reference.

The shampoo compositions which may be used typically comprise a surfactant selected from any one of a wide variety of surfactants known in the art (such as those described in U.S. Patent No. 4,854,333, incorporated herein by reference). The shampoo compositions may additionally comprise a compound considered useful for treating dandruff, e.g. selenium sulphide.

The compositions all may also optionally comprise a suspending agent, for example, any of several acyl derivative materials or mixtures thereof. Among these are ethylene glycol esters of fatty acids having 16 to 22 carbons. Preferred suspending agents include ethylene glycol stearates, both mono- and distearate.

Preferred alkanolamides are stearic monoethanolamide, stearic diethanolamide and stearic monoisopropanolamide. Still other long chain acyl derivatives include long chain esters of long chain fatty acids (e.g., stearyl stearate, cetyl palmitate), glyceryl esters (e.g. glyceryl distearate), and long chain esters of long chain alkanol amides (e.g., stearamide DEA distearate, stearamide MEA stearate).

Still other suitable suspending agents are alkyl (16 to 22 carbon) dimethyl amine oxides, such as stearyl dimethyl amine oxide. If the compositions contain an amine oxide or a long chain acyl derivative as a surfactant, these

- 19 -

components may also provide the suspending function and additional suspending agent may not be needed.

5 Xanthan gum is another agent used to suspend, for example, selenium sulphide which may be in the present compositions. This biosynthetic gum material is commercially available and is a heteropolysaccharide with a molecular weight of greater than 1 million. It is
10 believed to contain D-glucose, D-mannose and D-glucuronate in the molar ratio of 2.8:2.0:2.0. The polysaccharide is partially acetylated with 4.7% acetyl. Supplemental information on these agents is found in Whistler, Roy L. (Editor), Industrial Gums -- Polysaccharides and Their Derivatives New York: Academic Press, 1973. Kelco, a
15 Division of Merck & Co., Inc., offers xanthan gum as KeltrolR.

A particularly preferred suspending system comprises a mixture of xanthan gum, present at a level of from about
20 0.05% to about 1.0%, preferably from about 0.2% to about 0.4%, of the compositions, together with magnesium aluminum silicate ($\text{Al}_2\text{Mg}_8\text{Si}_2$), present at a level of from about 0.1% to about 3.0%, preferably from about 0.5% to about 2.0%, of the compositions. Magnesium aluminum
25 silicate occurs naturally in such smectite minerals as colerainite, saponite and sapphire. Refined magnesium aluminum silicates useful herein are readily available, for example as veegum, manufactured by R.T. Vanderbilt Company, Inc. Mixtures of suspending agents are also
30 suitable for use in the compositions of this invention.

Other useful thickening agents are the cross-linked polyacrylates such as those manufactured by B. F. Goodrich and sold under the Carbopol^(R) tradename.

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- 20 -

Another optional component for use in the present compositions is an amide. The amide used in the present compositions can be any of the alkanolamides of fatty acids known for use in shampoos. These are generally mono- and diethanolamides of fatty acids having from about 8 to 24 carbon atoms. Preferred are coconut monoethanolamide, lauric diethanolamide and mixtures thereof. The amide is present at a level of from about 1% to about 10% of the compositions.

The compositions may also contain nonionic polymer material which is used at a low level to aid in dispersing particles. The material can be any of a large variety of types including cellulosic materials such as hydroxypropyl methyl cellulose, carboxymethyl cellulose, hydroxyethyl cellulose and sodium carboxymethyl cellulose as well as mixtures of these materials. Other materials include alginates, polyacrylic acids, polyethylene glycol and starches, among many others. The nonionic polymers are discussed in detail in Industrial Gums, edited by Roy L. Whistler, academic Press, Inc., 1973, and Handbook of Water-Soluble Gums and Resins, edited by Robert L. Davidson, McGraw-Hill, Inc., 1980. Both of these books in their entirety are incorporated herein by reference.

When included, the nonionic polymer is used at a level of from about 0.001% to about 0.1%, preferably from about 0.002% to about 0.05%, of the composition. Hydroxypropyl methyl cellulose is the preferred polymer.

Another suitable optional component useful in the present compositions is a nonvolatile silicone fluid.

The nonvolatile silicone fluid may be either a polyalkyl siloxane, a polyaryl siloxane, a polyalkylaryl siloxane or a polyether siloxane copolymer and is present at a level

- 21 -

of from about 0.1% to about 10.0%, preferably from about 0.5% to about 5.0%. Mixtures of these fluids may also be used and are preferred in certain executions. The dispersed silicone particles should also be insoluble in the shampoo matrix. This is the meaning of "insoluble" as used herein.

The essentially nonvolatile polyalkyl siloxane fluids that may be used include, for example, polydimethyl siloxanes with viscosities ranging from about 5 to about 600,000 centistokes at 25°C. These siloxanes are available, for example, from the General Electric Company as the Viscasil series and from Dow Corning as the Dow Corning 200 series. The siloxane viscosity can be measured by means of a glass capillary viscometer as set forth in Dow Corning Corporate Test Method CTM0004, 20 July 1970. Preferably the viscosity of the these siloxanes range from about 350 centistokes to about 100,000 centistokes.

The essentially nonvolatile polyether siloxane copolymer that may be used is, for example, a polypropylene oxide modified dimethylpolysiloxane (e.g., Dow Corning DC-1248), although ethylene oxide or mixtures of ethylene oxide and propylene oxide may also be used.

Suitable silicone fluids are described in U.S. Patent No. 2,826,551, Geen; U.S. Patent No. 3,946,500, 22 June 1976, Drakoff; U.S. Patent No. 4,364,837, Pader; and British Patent 849,433, Woolston. All of these patents are incorporated herein by reference. Also incorporated herein by reference is Silicon Compounds, distributed by Petrarch Systems, Inc., 1984. This reference provides a very good listing of suitable silicone materials.

Another silicone material useful is silicone gum. Silicone gums are described by Petrarch and others

- 22 -

including U.S. Patent No. 4,152,416, 1 May 1979, Spitzer, et al., and Noll, Chemistry and Technology of Silicones, New York, academic Press, 1968. Useful silicone gums are also described in General Electric Silicone Rubber Product Data Sheets SE 30, SE 33, SE 54 and SE 76. All of these references are incorporated herein by reference.

"Silicone gum" materials denote high molecular weight polydiorganosiloxanes having a mass molecular weight of from about 200,000 to about 1,000,000. Specific examples include polydimethylsiloxane, (polydimethylsiloxane) (methylvinylsiloxane) copolymer, poly(dimethylsiloxane) (diphenyl) (methylvinylsiloxane) copolymer, and mixtures thereof. Mixtures of silicone fluids and silicone gums are also useful herein.

The shampoos described herein can contain a variety of other nonessential optional components suitable for rendering such compositions more formulatable, or aesthetically and/or cosmetically acceptable. Such conventional optional ingredients are well-known to those skilled in the art and include, e.g., preservatives, such as benzyl alcohol, methyl paraben, propyl paraben, and imidazolinidyl urea; cationic surfactants, such as cetyl trimethyl ammonium chloride, lauryl trimethyl ammonium chloride, tricetyl methyl ammonium chloride, stearyldimethyl benzyl ammonium chloride, and di(partially hydrogenated tallow) dimethylammonium chloride; menthol; thickeners and viscosity modifiers, such as block polymers of ethylene oxide and propylene oxide such as Pluronic F88 offered by BaSa Wyandotte, sodium chloride, sodium sulphate, propylene glycol, and ethyl alcohol; pH adjusting agents, such as citric acid, succinic acid, phosphoric acid, sodium hydroxide, sodium carbonate; perfumes; dyes; and sequestering agents, such as disodium ethylenediamine tetraacetate. Such agents generally are used individually at a level of from about 0.01% to about

- 23 -

10%, preferably from about 0.5% to about 5.0%, of the composition.

A typical shampoo composition might comprise (percentages by weight):

	(1)	Substituted Isethionate	5-15%;
	(2)	Anionic coactive	0-10%;
	(3)	Amphoteric coactive	0-10%;
10	(4)	Lauramide MEA	0-5%;
	(5)	Thickener	0-5%;
	(6)	Fragrance	0-2%;
	(7)	Preservative	0-1%; and
	(8)	Water	to 100%

15

Conditioner Compositions

A fourth embodiment of the invention, the substituted isethionate surfactant of the invention may be used in a conditioner composition such as is taught and described in U.S. Patent No. 4,913,828 to Caswell et al. which is hereby incorporated by reference.

More particularly, conditioner compositions are those containing a conditioning agent (e.g. alkylamine compounds) such as those described in U.S. Patent 4,913,828.

30

Cosmetic Compositions

In a fifth embodiment of the invention, the surfactant may be used in a cosmetic composition, such as is taught and is described in EP, 0,371,803.

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- 24 -

Such compositions generally comprise thickening agents, preservatives and further additions.

5 The composition may comprise polymer thickener in an amount sufficient to adjust the viscosity of the composition, so as to facilitate dispensing it conveniently onto the body surface.

10 Examples of polymer thickeners include: anionic cellulose materials, such as sodium carboxy methyl cellulose; anionic polymers such as carboxy vinyl polymers, for example, Carbomer 940 and 941; nonionic cellulose materials, such as methyl cellulose and hydroxy propyl methyl cellulose; cationic cellulose materials, such as
15 Polymer JR 400; cationic gum materials, such as Jaguar C13 S; other gum materials such as gum acacia; gum tragacanth, locust bean gum, guar gum and carrageenan; proteins, such as albumin and protein hydrolysates; and clay materials, such as bentonite, hectorite, magnesium
20 aluminum silicate, or sodium magnesium silicate.

Generally, the thickening agent may comprise from 0.05 to 5%, preferably 0.1 to 1% by weight of the composition.

25 The composition according to the invention can also optionally comprise a preservative to prevent microbial spoilage.

Examples of preservatives include:

30

(i) Chemical preservatives, such as ethanol, benzoic acid, sodium benzoate, sorbic acid, potassium sorbate, sodium propionate and the methyl, ethyl, propyl and butyl esters of p-hydroxybenzoic acid
35 2-bromo-2-nitropropane-1, 3-diol, phenoxyethanol, dibromodicyanobutane, formalin and Tricolsan. The

- 25 -

5 amount of chemical preservative optionally to be incorporated in the composition according to the invention will generally be from 0.05 to 5%, preferably from 0.01 to 2% by weight, the amount chosen being sufficient to arrest microbial proliferation.

10 (ii) Water activity depressants, such as glycerol, propylene glycol, sorbitol, sugars and salts, for examples alkali metal halides, sulphates and carboxylates. When employing a water activity depressant, sufficient should be incorporated in the composition according to the invention to reduce the water activity from 1 to <0.9 , preferably to <0.85
15 and most preferably <0.8 , the lowest of these values being that at which yeasts, molds and fungi will not proliferate.

20 The composition can also contain other optional adjuncts, which are conventionally employed in compositions for topical application to human skin. These adjuncts, when present, will normally form the balance of the composition.

25 Examples of optional adjuncts include vehicles, the selection of which will depend on the required product form of the composition. Typically, the vehicle when present, will be chosen from diluents, dispersants or carriers for the dialkyl or dialkenyl phosphate salt so as
30 to ensure an even distribution of it when applied to the skin.

35 Compositions according to this invention can include water as a vehicle, usually with at least one other cosmetically acceptable vehicle.

- 26 -

Vehicles other than water that can be used in compositions according to the invention can include liquids or solids as emollients, solvents, humectants, thickeners and powders. Examples of each of these types of vehicles, which can be used singly or as mixtures of one or more vehicles, are as follows:

Emollients, such as stearyl alcohol, glyceryl monolaurate, glyceryl monoricinoleate, glyceryl monostearate, propane-1, 2-diol, butane-1,3 diol, docosan-1,2-diol, mink oil, cetyl alcohol, isopropyl isostearate, stearic acid, isobutyl palmitate, isocetyl stearate, oleyl alcohol, isopropyl laurate, hexyl laurate, decyl oleate, octadecan-2-ol, isocetyl alcohol, eicosanyl alcohol, behenyl alcohol, cetyl palmitate, silicone oils such as dimethylpolysiloxane, di-n-butyl sebacate, isopropyl myristate, isopropyl palmitate, isopropyl stearate, butyl stearate, polyethylene glycol, triethylene glycol, lanolin, cocoa butter, corn oil, cotton seed oil, tallow, lard, olive oil, palm kernel oil, rapeseed oil, safflower seed oil, soybean oil, sunflower seed oil, olive oil, sesame seed oil, coconut oil, arachis oil, castor oil, acetylated lanolin alcohols, petroleum, mineral oil, butyl myristate, isostearic acid, palmitic acid, isopropyl linoleate, lauryl lactate, myristyl lactate, decyl oleate, myristyl myristate;

Propellants, such as trichloro-fluoromethane, dichloro-difluoromethane, dichloro-tetrafluoromethane, monochloro-difluoromethane, trichloro-trifluoromethane, propane, butane, isobutane, dimethyl ether, carbon dioxide, nitrous oxide;

Solvents, such as ethyl alcohol, methylene chloride, isopropanol, acetone, castor oil, ethylene glycol monoethyl ether, diethylene glycol monobutyl ether,

- 27 -

diethylene glycol monoethyl ether, dimethyl sulphoxide, dimethyl formamide, tetrahydrofuran;

5 Humectants, such as glycerin, sorbitol, sodium 2-pyrrolidone-5-carboxylate, soluble collagen, dibutyl phthalate, gelatin;

10 Powders, such as chalk, talc, fullers earth, kaolin, starch, gums, colloidal silicon dioxide, sodium polyacrylate, tetra alkyl and/or trialkyl aryl ammonium smectites, chemically modified magnesium aluminum silicate, organically modified montmorillonite clay, hydrated aluminum silicate, fumed silica, carboxyvinyl polymer, sodium carboxymethyl cellulose, ethylene glycol monostearate.

20 The cosmetically acceptable vehicle, when present, will usually form from 0.01 to 99.9%, preferably from 59 to 98% by weight of the composition, and can, in the absence of other cosmetic adjuncts, form the balance of the composition.

25 A wide variety of conventional sunscreens agents, such as those described in U.S. Patent No. 4,919,934 to Deckner et al. hereby incorporated by reference, may also be used in the cosmetic compositions of the invention.

30 Such agents include, for example, p-aminobenzoic acid, its salts and its derivatives, anthranilates, salicylates, cinnamic acid derivatives, di- and trihydroxy cinnamic acid derivatives, hydrocarbons such as diphenylbutadiene and stilbene, dibenzalacetone and benzalacetophenone, naphthasulfonates, di-hydroxy naphthloic acid and its salts, hydroxy diphenylsulfonates, coumarin derivatives, 35 diazoles, quinine salts, quinoline derivatives, hydroxy or methoxy substituted benzophenones, uric or vilouric acid,

- 28 -

tannic acid and its derivatives, hydroquinone, and benzophenones.

5 Toothpastes

10 In a sixth embodiment of the invention, the substituted isethonate surfactant may be used in a toothpaste composition such as is taught and is described in U.S. Patent No. 4,935,227 to Duckworth, which is hereby incorporated by reference.

15 Such compositions generally comprise abrasive gels (e.g. calcium carbonate), oral therapeutic agents (e.g., flourine containing compound), coactives, flavouring agents, sweetening agents, humectants and binding or thickening gels.

20 Preferred toothpastes of this invention comprise 0 to 1.5% by weight of anionic surfactant. In more preferred products the amount of anionic surfactant is 0 to 1% by weight with most preferred amounts being 0 to 0.75% by weight.

25 Toothpastes of this invention may include other surfactants, especially nonionic surfactants.

30 Toothpaste of the invention will also comprise the usual additional ingredients in particular humectant binder or thickening agent.

35 Humectants which may be used include glycerol, sorbitol syrup, polyethylene glycol, lactitol, xylitol or hydrogenated corn syrup. The total amount of humectant present will generally range from 10% to 85% by weight of the toothpaste.

- 29 -

Numerous binding or thickening agents have been indicated for use in toothpastes, preferred ones being sodium carboxymethylcellulose, cross-linked polyacrylates and xanthan gum. Others include natural gum binders such as gum tragacanth, gum karaya and gum arabic, Irish moss, alginates, and carrageenans. Silica thickening agents include the silica aerogels and various precipitated silicas. Mixtures of binders and thickeners may be used. The amount of binder and thickening agent included in a toothpaste is generally between 0.1 and 15% by weight.

Deodorant/Antiperspirants

In a seventh embodiment of the invention the compound of the invention may be used in deodorant/antiperspirant compositions such as those taught in U.S. Patent No. 4,919,934 to Deckner, U.S. Patent No. 4,944,937 to McCall and U.S. Patent No. 4,944,938 to Patini, all of which patents are hereby incorporated by reference.

Such compositions generally comprise a cosmetic stick (gel or wax) composition which in turn generally comprises one or more liquid base materials (e.g., water, fatty acid and fatty alcohol esters, water-insoluble ethers and alcohols, polyorganosiloxanes); a solidifying agent for solidifying the liquid base; and an active component such as bacteriostats or fungistats (for anti-deodorant activity) or astringent metallic salts (for antiperspirant activity).

These compositions may also comprise hardeners, strengtheners, emollients, colorants, perfumes, emulsifiers and fillers.

- 30 -

Shaving Creams and Lotions

In another embodiment of the invention, the substituted isethionate surfactants of the invention may be used in shaving cream or shaving lotion compositions. A typical shaving cream composition is set forth below:

	<u>Ingredients</u>	<u>% by Weight</u>
10	Stearic acid	20-40
	Coconut oil or fatty acid	6-10
	Substituted isethionate	1-45
	Glycerol	5-15
	Potassium hydroxide	2-6
15	Sodium hydroxide	1-3
	Vegetable or mineral oil	1-5
	Water	to balance

A typical brushless shaving cream composition is also set forth below:

	<u>Ingredients</u>	<u>% by Weight</u>
	Glyceryl monostearate	10-35
	Mineral oil	5-15
25	Substituted Isethionate	1-45
	Glycerol	1-10
	Water	to balance

A typical shaving lotion is set forth below:

	<u>Ingredients</u>	<u>% by Weight</u>
30	Cellulosic alkyl ether	70-75%
	Glycerol	3-10
	Substituted Isethionate	1-5
35	Mineral oil	10-20
	Water	to balance

- 31 -

Shower Gels

In yet another embodiment of the invention, the substituted isethionate surfactant may be used in shower gel compositions. A typical shower gel composition is set forth below:

	<u>Ingredients</u>	<u>% by Weight</u>
	Sodium cocoyl isethionate	5-10
10	Sodium ether lauryl sulphate	2-5
	Substituted Isethionate	1-45
	Coconut amidopropyl betaine	8-15
	Ethylene glycol distearate	4-10
	Isopropyl palmitate	0.5-1
15	Moisturizing factor	0.25-0.5
	Preservative	0.05-0.1
	Sodium chloride	3-5
	Water	to balance

While various compositions are described above, these should not be understood to be limiting as to what other personal product compositions may be used since other compositions which may be known to those of ordinary skill in the art are also contemplated by this invention.

25

Process Aspects

The processes described in the prior art can be used to obtain the surfactants described herein. The surfactants are more preferably prepared by a process comprising:

30

- a) preparation of the hydroxy alkane sulphonic acid or a salt thereof, and,

35

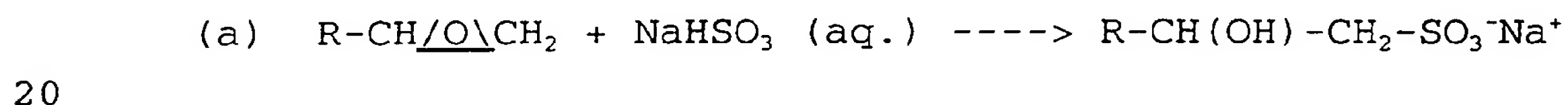
- 32 -

- b) condensation of the alkenoyl chloride with the product of step (a).

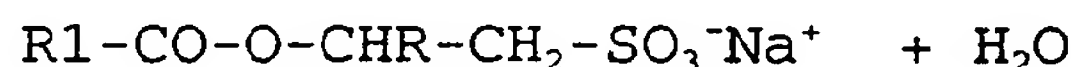
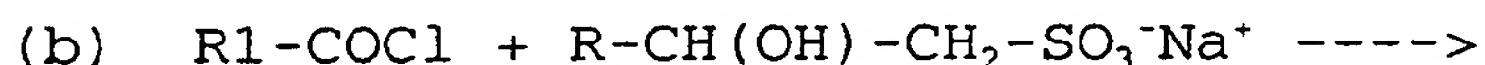
5 The hydroxy alkane sulphonic acids are preferably prepared from the appropriate 1,2-epoxyalkane and sodium metabisulfite in water. Typically, the resulting solids are recrystallised and dried thoroughly before use.

10 Further details of the preparation of the surfactants are given below.

15 Preferably, step (a) comprises preparation of the hydroxy alkane sulphonic acid from the corresponding 1,2-epoxyalkane by treatment with aqueous NaHSO_3 (formed by dissolution of $\text{Na}_2\text{S}_2\text{O}_5$ in water). The reaction is shown below, R being alkyl.



25 Preferably in step (b) the alkane sulphonic acid is treated with fatty acid chloride, either neat or in the presence of toluene, as indicated below:



30 As indicated above, the starting epoxide or fatty acid chloride can be have a mixture of alkyl groups. The group R_1 in the fatty acid chloride can be derived from coconut or other fatty acid, thus the resulting isethionate may comprise a mixture of alkyl groups. The reaction product
35 based on this will, generally be a mixture of branched

- 33 -

chain alkyl isethionates with a distribution of alkyl groups.

5 The invention is set forth in greater detail in the examples which follow below. These examples are merely to illustrate the invention and are again not intended to be limiting in any way. All parts, percentages and proportions herein are by weight unless otherwise indicated.

10

Examples

Example 1: (Comparative)

15

Preparation of Conventional Isethionate Compounds

20 Into a 500 Ml three-necked round bottomed flask equipped with mechanical stirrer, a gas inlet connected to a nitrogen source that extends to the bottom of the reaction vessel, a gas outlet leading to a sodium hydroxide trap, and an oil bath with a temperature controlled hot plate stirrer, is placed 90 g (0.608 moles) of dry sodium isethionate (ex Aldrich) and 139 g (0.635 moles) lauroyl chloride (ex Aldrich). This mixture is stirred and heated to 110°C for three hours. (As the temperature reaches 100°C a one phase reaction mixture results).

25

30 The reaction proceeds slowly until a temperature of 110°C is achieved; at this point, the reaction proceeds rapidly forming HCl gas. IR analysis of the solid formed shows a carbonyl stretch at 1735 cm⁻¹ for the ester and the disappearance of the acid chloride carbonyl at 1800 cm⁻¹. The reaction mixture is placed under vacuum to remove traces of HCl and excess lauroyl chloride.

35

- 34 -

The solid formed is removed from the vessel, washed twice with ethyl ether and dried.

5 Analysis of this solid by hyamine titration indicates that 97.06% reaction yield is realised. The solid obtained is then recrystallised twice using methanol and water. As an example, 100 g of material is recrystallised using 1,440 Ml methanol/405 Ml milli-Q water). The solid obtained is filtered and dried in a vacuum oven. The resulting
10 product is a white, crystalline, solid.

Analysis for % activity is achieved via hyamine titration and is 99+%. Chloride analysis via silver nitrate titration shows less than 0.3% chloride. Low levels of
15 lauric acid and sodium isethionate were determined using reverse phase and ion HPLC. Typical levels for the acid and isethionate are 0.06% and 0.113%, respectively. ¹H NMR (200 MHz, D₂O TMS) δ 4.43 (2H, t), δ 3.25 (2H, t), δ 2.38 (2H, t) δ 1.95-1.10 (18 H, m), δ 0.89 (3H, t).
20

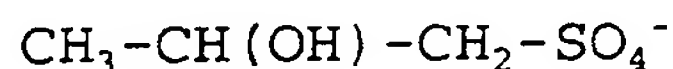
Example 2

Preparation of Branched Isethionates

25

The following examples illustrate the preparation of the 2-hydroxy alkyl sulphonic acids derivatives listed below as their sodium salts:

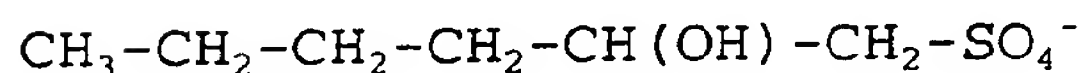
30



propyl



butyl



hexyl

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- 35 -

From these compounds the corresponding 2-methyl, 2-ethyl and 2-butyl isethionate esters can be prepared.

5 Example 2A: Preparation of sodium 2-hydroxypropyl
 sulphonate

10 Sodium 2-hydroxypropylsulfonate: Into a 250 mL three neck
Morton flask equipped with a magnetic stir bar, water
condenser and heating mantle is added 60 mL of milli-Q
water and 51.0 g (0.268 moles) of sodium metabisulfite
which is stirred until all solid is dissolved. To this
solution is added 34.4 g (0.592 moles, a 10% mole excess)
of propylene oxide (1, 2-epoxypropane) which is stirred
15 and heated to 60°C for 23 hours. The reaction mixture is
stripped of all water (and excess propylene oxide) under
reduced pressure and dried overnight in a vacuum oven with
heat. A white solid is recovered (81.85 g) containing
2.71% by weight sodium sulphite and 3.61% sodium sulphate
20 for an overall reaction yield of 88.24%. This material is
recrystallised from isopropanol/water, ¹H NMR (200 MHz D₂O,
TMS) δ 4.80 (1H, s), δ 4.35-4.16 (1H, m), δ 3.12-3.05 (2H,
d), δ 1.48 (3H, d).

25 Example 2B: Preparation of sodium 2-hydroxybutyl
 sulphonate:

30 Into a 2000 mL three-necked round bottomed flask equipped
with a magnetic stir bar, water condenser and heating
mantle is placed 450 mL of milli-Q water and 324.1 g
(1.7049 moles) of sodium metabisulfite which is stirred
until solubilised. To this is added 274.3 (3.804 moles)
of 1,2-epoxybutane which is stirred and heated to 40°C for
35 76 hours. After this time, the reaction mixture is cooled

- 36 -

and product precipitates out of solution; a first crop of crystals is recovered.

5 The filtrate is refrigerated for 24 hours after which time a second crop of crystals is recovered. The remaining filtrate is placed under reduced pressure to remove the solvent and the white solid recovered is washed three times in acetone and is then dried.

10 Total yield of recovered product is 613.88 g for a 91.6% reaction yield. The material contains 0.2% sodium sulphite and 0.4% sodium sulphate. The material is recrystallised from ethanol/water and dried thoroughly. ¹H
15 NMR (D₂O, 200 MHz, TMS) δ 4.75 (1H, s), δ 4.12-3.95 (1H, m) δ 3.20-2.95 (2H, d), δ 1.80-1.45 (2H, m), δ 0-.95 (3H, t).

20 EXAMPLE 2C: Preparation of sodium 2-hydroxy hexyl
sulphonate

Sodium 2-hydroxyhexylsulfonate: Into a 500 mL three-necked round bottomed flask equipped with magnetic stir bar, water condenser and heating mantle is placed 150 mL
25 of milli-Q water and 100.54 g (0.529 moles) of sodium metabisulfite which is stirred until fully solubilised. To this is added 118.6 g (1.184 moles) of 1,2-epoxyhexane. The reaction mixture is stirred and heated to reflux for 24 hours after which time the reaction vessel is allowed
30 to cool to room temperature. A white crystalline precipitate forms which is filtered and washed with acetone and dried. The filtrate is placed in the refrigerator and a second crop of crystals is recovered in 24 hours. The remaining filtrate is placed under reduced
35 pressure to obtain a tacky crystalline solid which is washed in acetone and dried. 174.69 g of product is

- 37 -

recovered for an 80.87% reaction yield. The material is recrystallised from ethanol/water and dried thoroughly. ^1H NMR (200 MHz, D_2O , TMS) δ 4.75 (1H, s), δ 4.0-4.2 (1H, m), δ 3.2-2.9 (2H, d), δ 1.75-1.10 (6H, m), δ 0.9 (3H, s).

5

EXAMPLE 3: Preparation of acyl esters:

Example 3A: Preparation of sodium lauroyl 2-methyl isethionate (SL2MI)

10

Sodium Lauroyl 2-Methyl Isethionate (SL2MI): Using the same reaction apparatus as described in Example 1 49.1 g (0.2244 mole) lauroyl chloride is added to 32.8 g (0.202 mole) of sodium 2-hydroxypropyl sulphonate prepared as above; the mixture is heated to 85°C for 2.5 hours. As in Example 1, IR analysis indicates the appearance of a carbonyl at 1735 cm^{-1} for the desired ester. The reaction mixture is placed under high vacuum to remove traces of HCl and excess lauroyl chloride and a solid results. This solid is removed from the reaction vessel and crushed using a mortar and pestle; this powder is washed several times with ethyl ether and petroleum ether to obtain a bright white solid. At this point, 68.3 g of product is recovered (a yield of 98.19%). Silver nitrate titration indicates 1.78% NaCl is present. The solid is recrystallised from 540 mL methanol and 100 mL milli-Q water at 40°C. The solid obtained was analysed as 99.56% active via hyamine titration; <0.019% sodium chloride, <0.05% lauric acid. ^1H NMR (200 MHz, D_2O , TMS) δ 5.45-5.3 (1H, m), δ 3.30-3.00 (2H, m), δ 2.35 (2H, t), δ 1.8-1.0 (21H, m), δ 0.88 (3H, t).

35

- 38 -

Example 3B: Preparation of sodium lauroyl 2-ethyl
isethionate (SL2EI)

5 Using the same reaction apparatus as described in Example
1, 69.2 g (0.287 moles) of lauroyl chloride is added to
50.6 g (0.287 moles) of sodium 2-hydroxy butyl sulphonate
prepared as above in 100 mL of reagent grade toluene.
After stirring and heating to 90°C for 1 hour, an opaque
white solution obtained. IR analysis indicates formation
10 of the desired ester noted by the carbonyl absorption at
1735 cm⁻¹.

The toluene and excess HCl is removed under reduced
pressure producing a viscous white liquid. This liquid
15 was analysed as 93.17% active via hyamine analysis
resulting in a reaction yield of 93%. Silver nitrate
analysis indicated 3.6% chloride present. This liquid is
dissolved in water producing a solution whose pH is equal
to 3; it is then treated with a dilute solution of sodium
20 bicarbonate until its pH is equal to 7. This step was
considered necessary to obtain particularly good yields of
material since HCl that was not removed previously would
hydrolyse the product during the recrystallisation step.

25 Subsequent freeze-drying of this solution produces a white
semi-solid. It is recrystallised from ethanol/water (500
mL/125 mL) and filtered under nitrogen and dried to obtain
a white wax-like solid. The material is analysed as
98.45% active by hyamine titration. It contains 0.27%
30 lauric acid, 0.36% sodium chloride. ¹H NMR (200 MHz, D₂O,
TMS), δ 5.4-5.2 (1H, m), δ 3.15 (2H.d), δ 2.40 (2H, t), δ
2.0-0.05 (26 H, m).

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- 39 -

Example 3C: Preparation of sodium lauroyl 2-butyl
isethionate (SL2BI)

Sodium Lauroyl 2-Butyl Isethionate (SL2BI): Using the
5 same reaction apparatus as described for SLI, 42.8 g
(0.2096 moles) of sodium 2-hydroxy hexyl sulphate is
added to 46.4 g (0.2120 moles) of lauroyl chloride in 60
mL of reagent grade toluene and is stirred and heated to
90-95°C for 90 minutes. After this time, IR analysis of
10 the reaction mixture indicates formation of the desired
ester (carbonyl absorption at 1735 cm⁻¹). The reaction
mixture is allowed to cool and is then placed under
reduced pressure at 35°C. A tan-coloured semi-solid is
produced; it is dried further in a vacuum oven overnight
15 at 45°C. A tan-coloured tacky solid is obtained; it is
dissolved in water producing a solution whose pH is equal
to 3. Treatment with dilute sodium bicarbonate solution
raised the pH to 5.5; subsequent freeze drying produced a
tan solid. Hyamine analysis indicates this solid is
20 97.19% active which makes for a 97.3% reaction yield. It
is recrystallised from isopropyl alcohol/water (650 mL/30
mL) to product a white solid. Hyamine analysis indicates
this solid is 99+% active. ¹H NMR (200 MHz, DMSO, TMS) δ
5.15-5.05 (1H, broad s), δ 2.7-2.6 (2H, d), δ 2.2 (2H, t),
25 δ 1.67-1.0 (30H, m), δ 0.85 (3H, t).

The results of the preparation of the sodium lauroyl alkyl
isethionates is summarised in Table 1 below:

- 40 -

TABLE 1

Active	CMC(mM) (1)	Krafft Temp. (2)	Foam Ht. in 120ppm Ca: initial /10min. (3)	%Zein Sol (4)	Ca ²⁺ for precip. (ppm) (5)	Stabil in H ₂ O (t _{1/2} , pH9,40 C) (6)
SLI	6.2	24	negl.	55	51	1.0
SL2MI	3.98	<0	negl.	54	69	5
SL2EI	2.5- 2.75	<0	160/150	55	1296 *	16.5
SL2BI	0.85	<0	negl.	44	127	>43 **

* does not form a solid but clouds out of solution

** projected to be around 100 (very stable to hydrolysis)

Each of these characteristics, how they are quantified, and an explanation of the significance of these numbers is set forth greater detail below.

1. Critical micelle Concentration (CMC)

The CMC is defined as the concentration of a surfactant at which it begins to form micelles in solution rather than precipitate. Specifically, materials that contain both a hydrophobic group and a hydrophilic group, (such as surfactants), will tend to distort the structure of the solvent (i.e, water) they are in and, therefore, increase the free energy of the system. They therefore, concentrate at the surface, orienting so that their hydrophobic groups are directed away from the solvent, the

- 41 -

free energy of the solution is minimised. Another means of minimising the free energy can be achieved by the aggregation of these surface-active molecules into clusters or micelles with their hydrophobic groups directed toward the interior of the cluster and their hydrophilic groups directed toward the solvent.

The value of the CMC is determined by surface tension measurements using the Wilhemy plate method. While not wishing to be bound by theory, it is believed that a low CMC is a measure of surfactant activity (i.e, lower CMC of one surfactant versus another indicates the surfactant with lower CMC is more surface active). In this regard, it is believed that lower CMC signifies that lesser amounts of a surfactant are required to provide the same surfactancy benefits as a surfactant with higher CMC.

As can be seen from the table above, the branched isethionates each exhibit lower CMC's than the parent SLI molecule, and are therefore believed to provide more effective surfactancy.

2. Krafft Points

The temperature at and above which surfactants begin to form micelles instead of precipitates is referred to as Krafft point (T_K) and at this temperature the solubility of an ionic surfactant becomes equal to its CMC.

Krafft point was measured by preparing a 1% dispersion or solution of the surfactant in water. If the surfactant was soluble at room temperature, the solution was cooled to 0°C. When the surfactant did not precipitate out, its Krafft point was considered to <0°C. If it precipitated out, the solution was slowly warmed with stirring in a

- 42 -

water bath. The temperature at which the precipitate dissolved was determined to be the Krafft point.

5 If the Krafft point was above room temperature, the solution was first heated rapidly to dissolve all the surfactant. It was then cooled until precipitation occurred, and was then slowly warmed to determine the Krafft point described above.

10 While not wishing to be bound by theory, it is believed that lower Krafft points are indicative of a surfactant being more soluble in an aqueous system. In addition, it is believed that surfactants with lower Krafft points are easier to formulate in multi-electrolyte systems because
15 of their greater tolerance to salt.

From the results given above it can be seen that the Krafft point of SLI is higher than the branched chain derivatives.

20

3. Foam Height

25 Foam is an important attribute in many consumer products. Foam is one of the dominant factors that determines the commercial value of products such as shampoo, soap, etc. Also, acceptability of many consumer products is closely related to the quality of texture and the foam they produce.

30

Since most of the foaming data on surfactants is typically obtained by the Ross-Miles method (Ross, J. and Miles, G.D, Am. Soc. For Testing Material Method D1173-53 Philadelphia, Pa. (1953); Oil & Soap (1958) 62:1260) the
35 foaming ability of these surfactants was also acquired using this method.

- 43 -

In the Ross-Miles method, 200 mL of a solution of surfactant contained in a pipette of specified dimensions with a 2.0 mm-i.d. orifice is allowed to fall 90 cm onto 50 mL of the same solution contained in a cylindrical vessel maintained at a given temperature (often 60°C) by means of a water jacket. The height of the foam produced in the cylindrical vessel is read immediately after all the solution has run out of the pipette (initial form height) and then again after a given amount of time (generally, 5 min.).

Using this method, the foam production (measure initially) and foam stability (the height after 10 minutes) are reported. All of the foaming wash achieved at 45°C in water with 120 ppm calcium hardness. The foam height is represented in millimetres (mm).

As indicated in the table above, foam heights in 120 ppm Ca for the unbranched isethionate is negligible. The foam height is excellent for the SL2EI. Negligible foam heights were obtained for the other branched derivatives.

4. Zein Test

Assessing Mildness

Many factors have been reported to have an influence on skin irritation such as removal of skin lipids, loss of naturally occurring hygroscopic materials in the stratum corneum, adsorption, protein denaturation, and epidermal lyposomal injury.

Although there are many hypotheses regarding skin irritation, it is generally believed that surfactants become irritants because they penetrate the stratum

- 44 -

corneum which a "barrier" and then react with the inner cells of the epidermis.

5 Traditionally, the study of percutaneous absorption has focused on measuring the diffusion of chemicals (e.g., surfactants through stratum corneum). Diffusion through an organ as complex as skin and its associated adnexal appendages is challenging to measure, model, and reproduce. Another challenge of cutaneous metabolism is
10 to assess the irritating potential, toxicity, and therapeutic potential of the penetrating compounds.

In vivo, the skin metabolism and percutaneous absorption are very difficult to measure. Finding adequate detection
15 methods and setting up proper experiments are not easy tasks. In vitro studies, however, are used because of the simplicity of the experimental conditions.

We have obtained information on mildness potentials of the
20 surfactants discussed herein by carrying out in vitro tests which have previously been demonstrated to correlate reasonably well with in vivo tests.

25 In Vitro Zein Solubilisation Test.

Gotte (E. Gotte, Proc. Int. Cong. Surface Active Subs., 4th Brussels (1964), 3, 83-90) and Schwinger (M.J. Schwinger, Kolloid-Z.Z. Poly., (1969), 233, 989) have
30 shown that a surfactant's ability to solubilise zein, an insoluble maize protein, correlates reasonably well with surfactant irritation potential. Specifically, the lower the amount of zein protein dissolved, usually the milder a surfactant is. Conversely, the more zein dissolved,
35 typically the more irritating the surfactant is. In order to test irritancy potential, a 1% solution of surfactant

- 45 -

(30 ml) was added to 1.5 g zein and stirred at room temperature for 1 hr. Residual zein was collected and dried to constant weight. Differences between starting and residual weights were used to calculate % zein dissolved.

In the table above, the materials used in the compositions and methods of the present invention dissolve about the same amount of zein as SLI indicating similar mildness.

5. Calcium sensitivity

The calcium ion stability of branched chain isethionates was measured by a modified Hart method (Witkes, et al. J. Ind. Eng. Chem., 29, 1234-1239 (1937)). The surfactant solution was titrated with a calcium ion solution. The endpoint was determined by visual observation of the cloudiness of the surfactant solution.

Many surfactants such as fatty soap are known to chelate to calcium ion to form calcium salts which are usually insoluble in aqueous media. This will lead to the loss of their surfactant properties. Calcium "insensitive" surfactants have unique advantageous properties for many applications such as a formulation for a liquid cleanser. In the case of the branched chain isethionates, it was noticed that a large amount of calcium ion was added before precipitation was seen. The precipitation limit was not reached even at levels well over an order of magnitude higher than the precipitation limit for the straight chain isethionate.

Overall, ethyl branching appears to substantially increase a surfactant's calcium stability. Surprisingly, the ethyl branched derivative requires nearly 1300 ppm Ca to come

- 46 -

out of solution. This is believed to explain why this material was able to foam in the presence of 120 ppm Ca. It should be stated that other branched chain isethionates precipitate out as a solids (presumably the calcium salt of the active); the ethyl branched material does not precipitate out as a solid but rather it appears to "cloud" out of solution. As the titration progresses, the clear surfactant solution becomes "blue" indicating that a structure is present which scatters light but no solid is seen. This solution becomes bluer and then cloudy; the endpoint for the titration is the point at which the solution appeared opaque. When this opaque mixture is allowed to sit undisturbed for several hours, the cloudiness settles into a clear, denser, liquid phase which adheres to the bottom of the vessel. This phase was noted as an isotropic solution by microscope and, after drying overnight in a heated vacuum oven, a tacky white solid is obtained.

20

6. Hydrolytic Stability

The actives were evaluated for its hydrolytic stability at pH 9, 40°C. The branched chains appear to be more hydrolytically stable at basic pH than the corresponding unbranched surfactants. It is theorised that as the amount of branching is increased, the stability increases.

The $t_{1/2}$ (half life) for these actives was determined by observing their decrease in concentration with time in a buffered solution using reverse phase HPLC. The actives were monitored at concentrations below their CMC using a reverse phase column and conductivity detection which allows for low level detection. By plotting the \ln concentration (or \ln area) with time, a straight line was noted indicative of pseudo first order kinetics. The

- 47 -

surfactants were prepared at 5×10^{-4} M in pH 9.0 buffer (NaHCO₃) and maintained in a water bath at 40°C. A 200 µl injection of each solution was made at various time intervals.

5

Column: Wescan Surfactant Column - Reverse Phase; 25 cm

Mobile Phase: 0.1% Ammonium Acetate in 45:55 ALN H₂O

10

Flowrate: 1 ml/minute

Detector: Conductivity (baseline conductivity 1030 µS);

15

Pressure: 200 psi

Retention Times: SLI ~5.0 minutes

SL2MI ~5.5 minutes

20

SL2EI ~6.0 minutes

SL2BI* ~5.5 minutes

* 4% acetonitrile was added to the mobile phase. The baseline conductivity was 960 µS.

25

Example 4: Foaming in the Presence of Other Surfactants

Solutions having 2mM actives were made up containing the branched chain isethionate, 120 ppm calcium and 1:3 ratios of cocoamine oxide: isethionate.

30

The results of foam tests run are reported in Table 2 below:

35

- 48 -

Table 2

Active	Foam Height (mm)
SLI (comp)	170
SL2MI	175
SL2EI	163
SL2BI	122

- 5 From the above it is seen that the actives foam in the presence of a zwitterionic surfactant such as a betaine or an amine oxide. Synergy between certain anionic surfactants and zwitterionics is reported by Rosen et al. in J. Phys. Chem., 68 3129 (1964) and in US 4,555,360.
- 15 This is thought to involve formation of a complex between the protonated cationic portion of the zwitterionic with the anionic yielding a product which is much more surface active than either material alone.
- 20 While the foam height of the branched chain isethionates as compared with SLI in water without calcium is not exceptionally different, in water with calcium added to approximate user conditions, the foaming improves and in the presence of selected zwitterionic surfactants improves
- 25 dramatically.

The results presented as Examples 1-4 show:

- 30 (1) The selected branched derivative of sodium isethionate can be prepared easily and in good yield via sulfonation of a 1,2-epoxyalkane with sodium bisulphite in water. Typical reaction yields were 80-93% of the resulting sodium 2-hydroxy alkane

- 49 -

5 sulphonate. These materials in turn were treated with lauroyl chloride either in the neat or in toluene solvent to prepare the corresponding sodium 1-alkyl 2-sulfoethyl laurate (sodium lauroyl 2-alkyl isethionate) in yields of >95%. Using various techniques the branched isethionate surfactants were purified to > 99% active.

10 (2) These branched surfactants exhibit increased hydrolytic stability as compared with SLI. Hydrolytic stability increases with the length of the alkyl chain.

15 (3) The branched homologues exhibit lower CMCs than the parent molecule. The CMC's decrease as the length of the branched side chain increases.

20 (4) The methyl and ethyl branched homologues show poor foam performance in milli-Q water as does SLI. SL2EI shows excellent foaming in the presence of 120 ppm Ca which is unlike SLI. These actives can be made to foam well in the presence of a zwitterionic surfactant such as a betaine or an amine oxide.

25 (5) The methyl and ethyl branched homologue shows similar mildness potential to SLI via the Zein solubilisation assay. The butyl homologue appears to be milder still from the results given.

30 (6) The ethyl branched derivative appears to show increased solubility in the presence of CaCl_2 as compared with SLI and the other branched actives in this series.

35

- 50 -

Example 5: Toilet Bar Compositions

Toilet bar compositions containing branched chain isethionate compositions (Examples 5A-5C) with a non-branched chain counterpart similar to commercial products (Comparative Example 5D) are prepared and the compositions are set forth in Table 3 below:

10 Table 3

Components %wt	5A	5B	5C	5D
Sodium Cocoyl Isethionate	-	-	24.89	49.78
15 SL2MI	51.37	-	-	-
SL2EI	-	42.00	25.69	-
Lauric acid	21.6	30.97	10.08	-
Stearic acid	-	-	10.08	20.15
Coconut fatty acid	-	-	1.54	3.01
20 Tallow and Coco. soap	8.02	8.02	8.02	8.02
Sodium Stearate	3.01	3.01	3.01	3.01
Na Alkylbenzene sulphonate	2.01	2.01	2.01	2.01
Sodium Chloride	8.34	8.34	4.3	0.35
Sodium Isethionate	-	-	2.34	4.68
25 Water	5.01	5.01	5.21	5.21
Minors	0.64	0.64	2.11	3.78

30 This illustrates the manufacture of a medicament for use in the treatment or prophylaxis of erythema.

- 51 -

Example 5: Light Duty Liquid Containing Branched Chain
Isethionates

A composition containing the following ingredients may be prepared with a composition as set forth in Table 4 below:

Table 4

Component	Wt%
Ammonium alkylbenzene sulphonate	16.0
SL2EI	13.0
Cocoamidopropyl betaine	4.0
Sodium Xylene sulphonate	5.0
Preservative, fragrance, dye and water	to 100%

Example 6: Facial Cleanser Containing Branched Chain
Isethionates

A composition containing the following ingredients may be prepared with the composition set forth in Table 5 below:

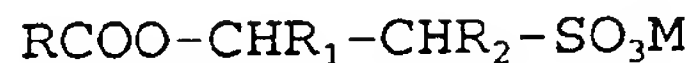
Table 5

Component	Wt%
SL2EI	13.0
Cocoamidopropyl betaine	4.5
Carbopol 940 (RTM)	1.0
Laponite (RTM) Clay	0.05
Lauric/Myristic acid	5.6
Sodium chloride	2.8
Preservative, fragrance and water	to 100%

CLAIMS

1. The substituted isethionate ester:

5

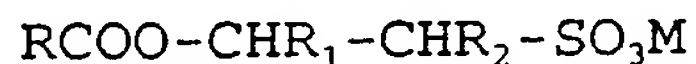


10

wherein M is a monovalent cation or equivalent thereof, R is alkyl, R1 is hydrogen or alkyl and R2 is hydrogen or alkyl, provided that R1 and R2 are not both hydrogen, for use in medicine.

2. The use of the substituted isethionate ester:

15

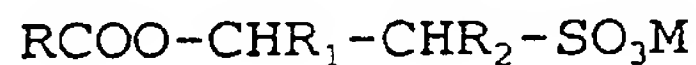


20

wherein M is a monovalent cation or equivalent thereof, R is alkyl, R1 is hydrogen or alkyl and R2 is hydrogen or alkyl, provided that R1 and R2 are not both hydrogen, for the manufacture of a medicament for use in the treatment or prophylaxis of erythema.

3. A method for the cosmetic treatment of the human body which includes the step of treating the surface of the skin with a composition including the substituted isethionate ester:

25



30

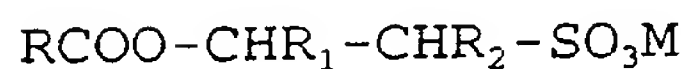
wherein M is a monovalent cation or equivalent thereof, R is alkyl, R1 is hydrogen or alkyl and R2 is hydrogen or alkyl, provided that R1 and R2 are not both hydrogen.

35

4. Personal washing composition comprising:

- 53 -

(a) the substituted isethionate ester:



5 wherein M is a monovalent cation or equivalent
 thereof, R is alkyl, R₁ is hydrogen or alkyl and R₂
 is hydrogen or alkyl, provided that R₁ and R₂ are not
 both hydrogen, and,

10 (b) at least 20% water.

5. Composition according to claim 4 wherein the R groups
 present are a mixture of primary, unbranched alkyl
 chain having over 95% of the carbon chain
15 distribution being between C₇ and C₁₇.

6. Composition according to claim 4 wherein the R₁ group
 is a primary, unbranched C₁-C₄ alkyl group.

20 7. Composition according to claim 4 wherein R₁ is methyl,
 ethyl or butyl and R₂ is hydrogen

8. Composition according to claim 4 further comprising
 at least one further surfactant other than soap.

25 9. Composition according to claim 8 wherein the at least
 one further surfactant comprises anionic, amphoteric
 or zwitterionic surfactant.

30 10. Composition according to claim 9 wherein the at least
 one further surfactant comprises a betaine.

35 11. Composition according to claim 9 wherein the at least
 one further surfactant comprises a fatty alcohol
 ether sulphate.

- 54 -

12. Composition according to claim 9 wherein the at least one further surfactant comprises an unsubstituted isethionate acyl ester.

INTERNATIONAL SEARCH REPORT

Inte onal Application No
PCT/EP 93/03065

A. CLASSIFICATION OF SUBJECT MATTER
IPC 5 A61K31/00 A61K31/185

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 5 A61K

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	FR,A,2 350 337 (HOECHST AG) 2 December 1977 see page 1 ---	1
A	US,A,2 999 871 (SCHENCK) 12 September 1961 cited in the application ---	
A	US,A,2 923 724 (ANDERSON ET AL) 2 February 1960 cited in the application ---	
A	FR,A,2 118 560 (PROCTER & GAMBLE) 28 July 1972 -----	

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

* Special categories of cited documents :

- * "A" document defining the general state of the art which is not considered to be of particular relevance
- * "E" earlier document but published on or after the international filing date
- * "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- * "O" document referring to an oral disclosure, use, exhibition or other means
- * "P" document published prior to the international filing date but later than the priority date claimed

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INTERNATIONAL SEARCH REPORT

information on patent family members

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